Rushing ruins livelihoods: Road safety in the taxi industry.

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Abstract

Taxis suffer a high rate of crashes, as is borne out by claims on third party insurance. Consequences of crashes are compounded for a taxi, as it means at least one driver and investors lose income, passengers may be injured, and the reputation of taxis as a safe conveyance diminished. The taxi industry has a complex structure; the main entities are the taxi company, taxi depot, taxi owner, taxi driver, and taxi license owner. For any taxi the five entities may be the same, different, or any one of the combinations in between and this complexity may be detrimental to enhancing safety. The current study explores the causes of taxi crashes and trials suitable interventions to reduce crash rates. Other than a tendency to blame other taxi drivers, or other drivers, the most often cited safety issue was paying attention, "be psychic, see four cars ahead". The Queensland Taxi Driver Questionnaire has been trialled and several initial observations made. Taxi drivers who purposely sped on residential streets were more likely to crash and to have incurred demerit points. While these results provide evidence that speed cameras are valid, other results point to "being in a rush" as the critical factor: Taxi drivers who try to get their passenger to a destination on time, regardless of the road rules, are more likely to crash, by contrast, taxi drivers who give safety of passengers a priority were less likely to crash. On the evidence of this initial pilot study, the questionnaire has been revised and is currently in distribution to a larger population of drivers. Industry factors are incorporated in the questionnaire informed by the theory of planned behaviour. Early in 2006 a magnetic pen operated computer used to assess drivers will be trialled with both novice and experienced taxi drivers.

Taxis suffer a high rate of crashes, as is borne out by claims on third party insurance. In Queensland in the 2000/01 financial year there was, on average, 80 third party insurance claims per 1000 taxis (based on data from Motor Accident Insurance Commission obtained from L. Russell, personal communication, 7 May 2004), compared to a rate of less than 5 claims per 1000 cars. There are also the crashes where there are no third party casualties. A major reason for high crash rates will be the amount of time taxis are on the road and thus exposed to the possibility of crashing. A typical taxi in Brisbane will be driven for about 150 000 kilometres per year, most of which are on urban streets, that is, at lower speeds and so for longer time than if the vehicle was driven on a highway.

Consequences of crashes are compounded for a taxi compared to private cars. For both taxis and private vehicles crashes may result in injury and occasionally death, time lost due to police investigations, processing insurance claims and organising repairs, and inconvenience such as greater difficulty in travelling to work or shops. A taxi involved in a crash also results in the driver losing time in which to earn income, and may lose his or her livelihood if the licence is suspended or cancelled, or if the depot manager or taxi owner refuses to hire a cab to the driver. Other drivers may also lose access to the cab if it is off the road. There is also an increase in costs for the industry, including insurance, repair, or write-off costs, and associated administration costs. At least one depot found it cost effective to write-off any cab that would be out of action for more than a day and a half (unless otherwise stated, reference to depot managers and cab drivers are the result of personal communications between the first author and industry members during the period from July2004 and November 2005). A number of depot managers claimed that the occasional big crash, while unwanted, was easier to deal with than the stream of minor crashes and scrapes which was a constant drain on time, money, and energy. This is somewhat contrary to the primary concerns in the road safety field, which is to reduce fatal and serious injury crashes (Queensland Transport, 2003).

One aim of this study is to explore the causes of taxi crashes. However, crashes do not happen in an organisational or social vacuum. Factors that affect regular drivers may differ from factors that affect taxi drivers, though there is likely to be many common factors. For example, whilst driving under the influence of alcohol is considered one of the “fatal 4” (Queensland Transport, 2003), because taxi drivers are professional drivers they have stricter alcohol limits, alcohol may not be a factor in their crashes. However, because taxi drivers spent long hours on the road, fatigue may be a fatal 4 factor that is particularly pertinent for taxi drivers. The Theory of Planned Behaviour (TPB, Ajzen, 1985, 1991) shall be utilised to provide a relatively simple structure to the many influences on taxi driving behaviour. This study also has the aim of finding ways of reducing crash rates. An apparently simple objective of crash reduction quickly becomes quite complex when individual differences of drivers, and their organisational, social, and road environments, are taken into account. A computer based driver assessment and feedback tool, and the proposed evaluation of this assessment tool, shall be described.

The Taxi Driver in the Organisational Environment

The main entities in the taxi organisation are the company, the depot, the cab owner, the driver, and the taxi license owner. The taxi company provides the communication base for both drivers and customers, determines the taxi livery and basic standards for drivers, trains drivers, provides a booking service, and provides emergency communication for drivers. Many taxis are operated out of a depot. Depots will look after the rostering of drivers, the pay-in of fares, and the maintenance and repair of the taxis. A depot may have some cars that are changed over, or garaged, at a driver’s residence. The taxi owner is the person or

company that actually owns or leases the taxi vehicle, and may be the depot, taxi company, or another entity. Each taxi vehicle must be linked to a taxi licence. Taxi licences may be owned by someone quite independent of the industry who leases the licence to the taxi owner as an investment.

Taxi drivers are not employees, but bailees. Essentially, they receive use of a taxi in return for paying a share of the fares to the operator: the driver usually retains about 45% of the fares. The bailor-bailee contract appears to be quite unique and different from contracts enjoyed by contract workers in other industries, where the worker is paid for a set amount of work. In the taxi industry, the driver pays the operator an amount dependent on what work happens to be available on the shift. For any taxi, the five entities may be the same, or different, or any one of the combinations in between. Whilst in many other fleets there may be a clear, if not always adequate, chain of responsibility and a hierarchical structure, the taxi industry is best considered a series of interrelated and overlapping entities. A study of a more simple hierarchical fleet organization, such as Swedish Televerket (Gregersen, Brehmer, & Moren, 1996), may not be applicable in the context of Queensland's taxi organisation. In Swedish Televerket training activities to improve safety, were undertaken by drivers as part of their paid work, and paid for by the company. For Queensland taxi drivers such training is inevitably in their own time and at their own expense.

Drivers vary greatly in the income they earn, typically they may clear about $10 to $14 per hour, which is quite low by Australian pay rates (Queensland Department of Industrial Relations & Queensland Transport, 2001). The generally low rates of pay may encourage drivers to sacrifice safety as they attempt to maximise income by speeding and working long hours, about 50 to 60 hours per week (Dalziel & Job, 1997; Queensland Department of Industrial Relations & Queensland Transport, 2001). The result is that fatigue may be a potential problem among taxi drivers, but past studies have found limited evidence to support this contention (Dalziel & Job, 1997; Koh, Ong, and Phoon, 1986).

Strictly speaking, taxi drivers do not have a supervisor they are answerable too. Where and how they work is up to the driver. They are quite at liberty not to take jobs that are advised over the dispatch system, and at peak times such as Friday and Saturday nights most drivers prefer to work busy ranks than to accept bookings for passengers that may not turn up or not wait for them. Whilst taxi drivers have a high level of independence, they may have a depot manager or taxi owner who expects minimum levels of pay-ins. There are agreed ways in which fares and costs are split between depots or owners and drivers, and in the event of crashes or customer complaints drivers may be talked to or reassessed by the owner, depot staff, or the taxi company. Depot managers or taxi owners may refuse to hire a vehicle to a driver, or the driver can quite easily find someone else to drive for. Another factor is that taxi drivers are exempt from wearing seat belts, the justification being that seat belts could be used as a weapon by aggressive passengers. Also, there are some additional distractions for taxi drivers compared to most drivers: passengers who are usually unknown to them (Regan & Mitsopoulos, 2001), and the dispatch and communications systems (Bylund, Bjornstig, & Larsson, 1997; Dalziel & Job, 1997).

Initial data collection

Qualitative Data

Qualitative data collection has been based on interviews with depot and company managers, focus groups with drivers, and discussions with individual drivers. Focus groups have not been as formal as is common for other groups of participants: Taxi drivers often work 10 to 12 hour shifts, and while changeover may nominally be at 4pm, it will often go for more than an hour. Drivers who finish early do not want to have to wait for late-arriving drivers before discussing road safety and other issues. There were similar problems for

drivers beginning their shift; as soon as their car arrived they wanted to be on the road earning a living. Thus, there was often a rolling membership of focus groups.

Drivers proposed that safe driving behaviours included paying attention and being aware of the road surrounds, for example, "be psychic, see four cars ahead"; using turn indicators; and not taking personal problems onto the road. Drivers said that factors that increased the likelihood of crashes were: fatigue because of long shifts, pressure from passengers, pedestrians wandering across the road, driving too fast, tailgating, or generally being in a rush, and poor training or screening of drivers at intake. A number of Brisbane drivers reported that police were pedantic in applying traffic laws rather than being interested in road safety and customer service, and there was a reluctance to help the police. This was a contrast to a regional area where police were much more cooperative, for example, letting cabs with no passengers speed back to ranks on busy nights, and drivers were much more willing to cooperate with police requests.

Whereas drivers had concerns about police, managers had similar concerns about Queensland Transport. Yet, while one manager complained that Queensland Transport enforced low fares, thus forcing drivers to rush and drive long hours, another said the problem was that too much money was taken out of the industry by taxi license holders. Some depot managers joined drivers in expressing concern about drivers who speed, tailgate, or are generally in a rush. Both drivers and managers had concerns about the apparent lack of training and rigorous assessment of new taxi drivers. One depot paid for driver training courses attended by their drivers, but other managers thought such a move was not cost-effective because of the high turnover of drivers. In fact, there were limited suggestions for improving road safety in the taxi industry, with some managers saying nothing could be done. All depots regularly had basic maintenance checks of cabs, usually at the end of each shift. Additionally, various systems were employed to have drivers report faults at the end of each shift, or earlier if the need arose. Yet some drivers preferred to drive a vehicle that had low oil level, despite the danger to the engine, rather than immediately report the fault to the depot and thus lose time and income. A number of depot managers and a taxi owner believed drivers needed to take responsibility for their driving actions, despite the majority of depots requiring drivers who crashed pay a higher insurance levy for each shift, or to pay some of the repair costs. There was also concern about "cowboys", and connections were drawn between drivers who treated their customers well, what is termed customer focus, and safe drivers. There was some disagreement about whether fatigue was an issue. While taxi drivers have shifts up to 12 hours, or longer, rather than drive on monotonous rural highways they drive in an changing urban environment with a variety of passengers. A number of these issues will be taken up later, particularly in terms of developing the questionnaire.

Quantitative Data

Types of Taxi Crashes in Queensland. Table 1 lists the number and rate of different categories of crashes over two 6-month periods. The category with the largest number of crashes for all cars is where vehicles are travelling in the same direction along the same road. Taxis have an even higher rate of this type of crash, due to a higher rate of rear-end crashes compared to other cars. These rear-end crashes are likely to be caused by factors mentioned by drivers and managers themselves, speed, following too close, and a lack of attention. Pedestrian crashes are more common for taxis than other cars: According to taxi drivers this is due to the peak periods on Friday and Saturday nights, and into the following mornings. At these times taxis converge on busy ranks near night clubs and other entertainment places, where people who are affected by alcohol or other drugs congregate, walk along or across roads, or dash out to hail a passing taxi.

Table 1
Number of crashes where taxis or other cars are involved according to Queensland Transport[a] crash description for the period April to September 2003 and 2004.

DCA	Category		Apr – Sept 2004		Apr – Sept 2003	
			% of taxi crashes	% of all car crash	% of taxi crashes	% of all car crash
00n[b]	Pedestrian		7.6	3.0	11.5	3.5
10n	Veh's adjacent approach		22.9	18.2	22.0	18.5
20n	Veh's opposite approach		16.7	15.1	12.4	15.2
30n	Veh's same direction		41.4	32.1	39.0	32.6
40n	Veh's manoeuvring		5.2	4.5	4.1	3.9
50n	Veh's overtaking		0.0	1.2	1.8	1.3
60n	Veh's on path		1.4	4.2	1.8	4.5
70n	Off-path-straight		3.3	12.8	4.1	12.2
80n	Off-path-curve		0.0	8.3	1.4	7.9
90n	Pass & Misc		1.4	0.6	1.8	0.5
	Total percentage		100.0	100.0	100.0	100.0
	Total number		210	8976	218	9095
301	Veh's same direction	rear-end	25.7	17.6	26.1	18.0
30n-301	Veh's same direction	not rear-end	15.7	14.5	12.8	14.6

Notes. [a]The Queensland Government transport department. [b]Crashes involving pedestrians are coded from 000 to 009, with similar coding for other categories.

Severity of crashes. The severity of reported taxi crashes are listed in Table 2. There was just one fatality among taxi crashes in the 6-month period, more often there would be no fatalities. The low fatality rate is at least partly explained by taxis being driving mostly over low speed urban roads. However, taxis have higher rates of hospitalisation and injuries requiring medical treatment, particular in the more congested southeast region of Queensland. The marked difference between severity of taxi and other car crashed outside southeast Queensland is likely due to other cars being driven on rural roads and highways, whereas taxis are largely confined to towns and regional cities with slower speeds than rural roads, but not the congestion of southeast Queensland.

Table 2
Number of crashes where taxis or other cars are involved according to Queensland Transport for the period April to September 2004.

	Percentage of all taxi crashes			Percentage of all other car crashes		
	SE Qld	Other Qld	All Qld	SE Qld	Other Qld	All Qld
Fatal crashes	0.6	0.0	0.5	0.8	1.3	1.0
Hospitalisation	25.2	8.5	21.4	19.2	20.5	19.6
Medical treatment	27.0	25.5	26.7	23.7	19.1	22.2
Minor injury	11.0	21.3	13.3	15.3	11.4	14.0
Property damage only	36.2	44.7	38.1	41.0	47.8	43.2
Total percentage	100.0	100.0	100.0	100.0	100.0	100.0
Total crashes	163	47	210	6048	2929	8977

Contributing circumstances to crashes. Queensland Transport data on contributing circumstances for April to September in 2003 and 2004 offer some explanation for the types of crashes. The overrepresentation of taxis in intersection crashes may be due to an overrepresentation of intersection violations, such as disobeying traffic lights and give way signs. A higher rate of violations involving following too closely, undue care and attention, and unsafe lane changes, helps to explain the higher rate of rear-end crashes. Undue care and

attention could be due to a multitude of possible distractions, for example, the computer dispatch system, unfamiliar passengers, and reading street maps. Taxi drivers' claims to mitigating circumstance in regard to pedestrian crashes receives some support in that only rarely did taxi drivers have "failing to give way on pedestrian crossing" assigned as a cause. The driving experience of taxi drivers, and their familiarity with the roads, is demonstrated by being less likely to have inexperience or driving conditions (glare, wet roads) as contributing circumstances. The contributing circumstances data suggests that the factors of intersections violations (disobeying traffic lights and intersection signs), distraction, and close following are particularly relevant.

Table 3
Contributing circumstances to taxi and other car crashes for April to September of 2003 and 2004.

Circumstances[a]	Percentage of crash circumstances listed			
	April to September 2003		April to September 2004	
	% taxi circumstances	% car circumstances	% taxi circumstances	% car circumstances
Taxis overrepresented				
Disobey give way sign	7.39	5.35	6.14	5.17
Disobey traffic lights	5.99	1.64	8.19	2.95
Disobey traffic sign	0.00	0.44	1.71	0.52
Follow too closely	6.69	5.16	8.19	4.95
Improper turn (not U)	2.82	1.73	0.34	0.43
Improper U-turn	2.11	1.22	3.41	1.05
Turn in face of oncoming traffic	5.28	5.92	7.17	5.59
Undue care & attention	22.54	20.14	21.50	20.79
Unsafe lane change	2.46	1.13	1.71	1.22
Inattention/negligence	3.17	1.12	3.75	1.18
Other cars overrepresented				
Alcohol - over the limit[b]	1.41	4.18	3.41	4.21
Age (lack of perception, power…)	1.76	2.23	2.05	4.21
Fatigue related by definition	0.70	1.10	0.00	1.26
Inexperience/lack of expertise	8.10	13.81	9.56	12.86
Medical condition (heart attack)	0.00	1.08	1.02	1.11
Sunlight glare	0.70	1.09	0.00	1.25
Wet/slippery road	0.70	3.72	1.37	3.21
Animal on road	0.35	0.27	0.00	1.35
Excessive speed	0.70	2.36	0.68	2.27
Total number	284	13 746	293	14 115

Notes. [a]Only circumstances where the difference between taxis and other cars is greater than 1% for at least one period of time are listed. [b]Taxi drivers have a stricter BAC limit, thus may be other car drivers with BAC equal to that of taxi drivers, but not caught because below BAC = .05% rather than no alcohol.

Preliminary questionnaire results. A preliminary QTDQ was trialed among taxi drivers in November 2004, with 43 questionnaires completed at a return rate of about 45%. Taxi drivers who reported disregarding the speed limit on residential streets were more likely

to crash (r = .50, p < .01) and to have incurred demerit points (r = .40, p < .01). While these results provide evidence that speed cameras and other enforcement measures are valid, other results suggest ways of expanding on the factor of speed. Taxi drivers who try to get their passenger to a destination on time regardless of the road rules, are more likely to crash (r = .38, p < .05), as are drivers who believe it acceptable to take a risk overtaking (r = .35, p < .05), and who believe there are not enough driver to do the work (r = .45, p < .01). By contrast, taxi drivers who give safety of passengers a priority appeared to be less likely to crash, a result in line with Lajunen and Summala (1995), though it did not reach significance (r = -.30, p = .06). Thus it can be argued that taxi drivers who had a sense of urgency and seem to be in haste, and so will speed and tailgate, are more likely to crash than drivers who want their passengers to feel safe.

Summary of Initial Data Collection

In terms of driving behaviour, a major concern of drivers and managers was speed, tailgating, rushing, and inattention. Queensland Transport data demonstrated that taxis are overrepresented in rear end crashes, as well as pedestrian and some types of intersection crashes; and that taxis were overrepresented in disobeying intersection lights and signs, close following, and inattention. Finally, preliminary survey results clearly demonstrate that intentionally speeding, and trying to meet passenger deadlines, is associated with crashes. This evidence points to drivers who fail to pay attention to the driving task, and those who rush, and so speed, tailgate, or fail to obey intersection rules, are more likely to crash. There is anecdotal evidence that taxi drivers rush in an attempt to increase income. The new version of the QTDQ specifically includes this issue as a potential organizational pressure on taxi drivers. Clearly, organizational factors must be included in a systematic way.

Theoretical Issues

Theory of Planned Behaviour

The Theory of Planned Behaviour (TPB, Ajzen, 1985, 1991) was developed from the Theory of Reasoned Action (TRA, Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). The success of the TRA in finding significant relationships between attitudes and behaviour was due to the inclusion of intentions, and an insistence on a correspondence between the attitudes, intentions, and behaviours being measured. Fishbein and Ajzen made the assumption that most socially relevant behaviour is under the control of the person concerned, therefore intentions determine behaviour. Intentions could be predicted by the person's attitude toward the behaviour, and their subjective norms. Subjective norms are what the person perceives the beliefs of significant others toward the behaviour is, and their motivation to comply with such beliefs: A taxi driver may think other taxi drivers believe speeding is dangerous, but because they have no motivation to comply with other taxi drivers, they intend to speed anyway. Attitudes to a behaviour are formed from the person's beliefs about the outcomes of a behaviour and their evaluation of those outcomes: A taxi driver may believe that seatbelts will reduce injury in a crash, but can also be used as a weapon by a disgruntled passenger, whether the driver intends to wear the seatbelt will depend on their evaluation of these competing beliefs.

To be able to find significant relationships, there must be a correspondence in what is measured between subjective norms and attitudes, intentions, and behaviours (Ajzen & Fishbein, 1980). If the behaviour to be measured is which party the person will vote for at the next state election, then intentions, attitudes, and subjective norms must also relate to that particular behaviour. If the attitude measured is that safe driving is important, that may have little relevance to particular driving behaviours. Asking the driver whether they drive safely is not helpful. The driver may believe they can safely drive even when they drive at 120

km/h in a 100 zone, and thus will willingly speed on a highway. Driving safely is a behavioural category rather than a behaviour. There will be several, maybe many possible behaviours, within the one category, rarely will a person undertake all those behaviours (Ajzen & Fishbein, 1980). However, it may be possible to measure how much a person undertakes safe driving by measuring how frequently they undertake a range of specific driving behaviours.

Safe driving behaviours suggests a measure of outcomes, in particular, decreased crash rates. Ajzen and Fishbein (1980) warn against confusing behaviours with outcomes. The outcome of a person losing 10kg may be because of dieting behaviour, or because of increased exercise behaviour, a new job involving increased physical activity, other members of the family refusing to buy fatty foods, or other factors. It is appropriate to identify the driving behaviours that are associated with a lower crash rate, but there are also many other factors including road conditions, traffic conditions, weather, health, and the condition of the car. Crash rates can be used to identify which driving behaviours of taxi drivers are relatively safe or dangerous, and drivers measured on those behaviours, but because of the numerous other factors, prediction of which drivers will have crashes is difficult.

While external factors have an influence on intentions, and thus behaviour, Ajzen and Fishbein (1980) argue that these influences are always via attitudes and subjective norms. External factors are those external to the model, not to the person, and can include age, education level, sex, ethnicity, and training. Being young in itself does not make one a less safe driver, but young people are more likely to have certain attitudes and subjective norms which are associated with more dangerous driving intentions. For example, most people drive more safely when they have passengers in the car, the main exception being young men who have young men as passengers (Chen, Baker, Braver, & Li, 2000; Regan & Mitsopoulos, 2001; Rueda-Domingo et al., 2004; Vollrath, Meilinger, & Kruger, 2002): This suggests that particular subjective norms that lead to more dangerous driving become more salient for young male drivers when fellow young males are passengers.

Ajzen (1985; 1991) removed the assumption that most socially relevant behaviour is under the control of the person concerned when he developed the TPB. The TRA became a special case of the TPB: When the behaviour was under complete volitional control, then there was no need for the new factor introduced to create the TPB. The new factor, perceived behavioural control (PBC), was hypothesized to affect behaviour, both directly and via intentions (see Figure 1). PBC is most closely related to self-efficacy (Ajzen, 1991). However, it refers to more than the skills of the person to perform the behaviour, but rather their ability to control their performance of the behaviour given their skills and other limitations in the environment.

See Appendix for Figure 1

A meta-analysis (Armitage & Conner, 2001) brought together the results of 185 tests of the TPB found in 161 articles. Overall, attitudes, subjective norms, and perceived behavioural control accounted for 39% of the variance in intentions, whilst intentions and perceived behavioural control accounted for 27% of variance in behaviour. Attitudes were the strongest predictor of intentions, and subjective norms the weakest. One explanation for the low result for subjective norms is that in many studies they are measured by a single item. Indeed, Armitage and Conner (2001) found that when subjective norms were measured by multiple items, subjective norms then correlated more strongly with intentions. Behaviours were more strongly predicted when they were self-reported than when the behaviour was observed. Part of the reason may be that when participants answer questionnaires they want to be consistent, and so tend to answer questions on behaviour in line with other questions.

Additionally, answering questions on intentions, behaviours, and then other factors in what is perceived to be a socially acceptable way will increase the likelihood of strong correlations between the answers. Observing behaviour may be more objective, and was used in one study of taxi driver behaviour where observers posed as passengers (Burns & Wilde, 1995). However, observation can have problems in cost, time sampling errors, and the reaction of participants to being observed.

TPB Applied to Road Environment

Parker and her colleagues (Parker, Manstead, Stradling, Reason, & Baxter, 1992) used self-report measures to find evidence of whether the TPB was applicable in the road environment. They found that perceived behavioural control improved the prediction of driving intentions. There was no attempt to measure actual behaviour, thus it could not be confirmed that driving intention resulted in the behaviour intended, and it could not be assessed if perceived behavioural control had a direct effect on behaviour. Contrary to the general trend, Parker et al. found that the strongest predictor of intent was subjective norm. The reason for this strong result is unclear. Subjective norms were best at predicting the intentions of younger male drivers: this is in line with results of studies that found passengers had more influence over young males rather than any other group of drivers (Chen et al., 2000; Regan & Mitsopoulos, 2001; Rueda-Domingo et al., 2004; Vollrath et al., 2002). This would only partly explain the strength of the subjective norm results. The study seems to have been sound with a large sample size (over 800).

Other studies in the road safety area have, contrary to Parker et al (1992), found subjective norms to be the weakest of the predictors for intentions and behaviours. The TPB was used as a basis for a mass media campaign to reduce speeding (Stead, Tagg, MacKintosh, & Eadie, 2005). Elliot, Armitage, and Baughan (2003) used self-reports of future speeding behaviour by administering the behaviour questionnaire three months after the questionnaire measuring the other TPB variables. They found that after demographic variables were taken account of, attitude, subjective norms, and PBC accounted for about 53% of variance in behavioural intentions, whilst intentions and PBC accounted for about 32% of variance in future behaviour. A study of speeding behaviour (Aberg, Larsen, Glad, & Beilinsson, 1997) adjusted TRA by including the social environment, that is, drivers perception of how fast other drivers went. Subjective norms were not measured. Support was found for this variation of the TRA (Aberg et al., 1997). However, it can be argued that perception of how fast other drivers went is a subjective norm based on observation. In the TPB both subjective norm and PBC enable the researcher to investigate influences from outside the participant. However, those influences, whether it be observation of the behaviour of other drivers, demands from a supervisor, or advise from a family member, must be perceived, interpreted and given weight by the participant.

TPB and Taxi Road Safety

Figure 2 is a diagrammatic presentation of applying the TPB to taxi road safety. The standard TPB precursors to attitudes, subjective norms, and PBC are not included. However, some factors that are expected to predict PBC are included, in particular perceptions of pressure from the organizational and road environments. These are included to measure how much organizational factors influence taxi drivers, rather than to find a comprehensive list of factors that affect PBC. The TPB has also been extended by having behaviour predicting the outcome of crash rates. There will be many factors involved in crash rates besides the driving behaviour of the taxi driver, for example, the behaviour of other drivers and problems with a vehicle or the road. These factors will not be measured.

See Appendix for Figure 2

The operational definition of unsafe driving behaviours is those driving behaviours associated with higher levels of crashes. An alternative would be to base unsafe behaviour on the level of at-fault crashes, because if the driver is not at-fault, then the driver's behaviour was not implicated in the crash (af Wahlberg, 2003). However, attribution of fault is a policing, legal, and insurance issue, and may not truly reflect who was actually at fault in terms of driving behaviour. An example would be a taxi being hit by a car that failed to obey a give way sign. While the police and insurance companies will assign fault to the other car, it could be that the taxi driver should have been more alert to the offending car and taken evasive action. Additionally, crashes are fairly rare, which means ruling out not-at-fault crashes may mean the sample size of crashes becomes too small. As was demonstrated above, unsafe driving behaviours include speed, close following, disobeying traffic lights and signs, fatigue, failure to avoid pedestrians, and distraction and inattention. Each of these driving behaviours will be measured for each TPB factor. In this way some of the complexity of driving behaviour can be captured, as well as making it possible to isolate some of the elements of driving behaviour important to the taxi industry.

Feedback

As well as investigating current road safety in the taxi industry, this project is to assess technological based interventions designed to improve road safety. The proposed technology utilizes feedback to drivers. Interventions using technology to provide the basis of feedback has been trialed before. In Belgium and the Netherlands, either accident data recorders or journey data recorders were introduced to seven fleets (Wouters & Bos, 2000). Change in crash risk ranged from an increase of a statistically nonsignificant 13% for a truck fleet to a decrease of 72% for a bus fleet. Wouters and Bos found a significant overall reduction in crash risk of 20% when compared to control groups. There are, however, a number of difficulties with this study. The small sample sizes and the variable crash records inflated confidence intervals. Feedback, which was the responsibility of fleet owners, was not controlled in the experiment, and the nature of the feedback was not clarified. This taxi project will differ in its use of a technology based feedback intervention by having the assessor present in the car, and having greater control of the feedback.

An investigation that more rigorously controlled feedback sessions based on data logger information was carried out by Sheahan and Biggs (2005). Participants were trainee bus drivers who were assigned to three groups, data logger with camera, data logger without camera, and control. Some of the results were confounded by ceiling effects. The trend was that the data logger without the camera was beneficial; however, the results were not statistically significant, with the small sample size being one of the possible reasons. Another reason may be that the feedback provided by the data logger related to higher order driving competencies, and thus was not applicable to trainee bus drivers.

Control of feedback is necessary because the type of feedback, and the medium of the feedback, impacts on its efficacy (Kluger & DeNisi, 1996). In a series of university and workplace based experiments Baron (1988) confirmed that constructive feedback was specific, prompt, and considerate. The constructive feedback reduced conflict, whilst destructive criticism undermined the recipients confidence, self-efficacy, and future performance, but increased avoidance behaviours. Feedback that is specific will indicate where the recipient has done well or poorly at the relevant task, this allows the recipient to know where good work can be consolidated, and what improvements can be made. The alternative is generalizations such as "You have done well" or "that is a poor piece of work". Considerate feedback is when the needs and feelings of the recipient are taken into account

when the feedback is given. Considerate feedback will keep to the issue of performance rather than to denigrate (or overly praise) the recipient.

An experiment by Liden and Mitchell (1985), that measured the reactions of university students to exam feedback, found that recipients rated specific feedback more positively than nonspecific feedback. Students who received a maximum of three pieces of information attributing poor results to internal causes had significantly lower intentions to study in the future than students who received fewer attributions of internal cause. Liden and Mitchell suggest there may be a point at which recipients give up if they receive too much feedback that attributes failure to internal causes, but they were unwilling to specify a level based on an experimental study. However, a related issue here is that constructive feedback will be considerate of how much negative feedback, and the sort of negative feedback, that recipients may be able to positively respond to.

Two other dimensions of feedback are its sign and its credibility. Positive feedback may make the person feel successful, but it is negative feedback that improves the performance of the recipient (Podsakoff & Farh, 1989), this is particularly so when the feedback has higher credibility. In an experiment using university students Podaskoff and Farh had manipulated credibility by saying the feedback was based on the evaluators experience, or by displaying tables indicating the feedback was based on a comparison to 300 students who had completed the same test. The high credibility data based feedback resulted in greater improvement in performance and the setting of higher goals, than the low credibility feedback that was based on opinion.

The medium of feedback can be divided into either human or computer, with the human medium being supervisor, peers, or subordinates. Kluger and Adler (1993) provided feedback via either a computer or a human, either on request or automatically, to university students solving math problems. All feedback reduced performance, with the feedback from the human having the most negative effect. However, the smaller negative effect for feedback provided through the computer may be because of convenience, the students were working on computers. Additionally, feedback was only about outcome, whether the student answered the question correctly or not. Process feedback, that is, feedback on how to go about the particular task, may yield quite different results. Whereas a person telling a subject whether they were right and wrong may simply decrease self-esteem, a person explaining to another person how to complete a task successfully can conceivably improve performance.

A number of the issues in regard to feedback have been brought together in a recent study by Alder and Ambrose (2005). They hypothesized that subject control over the timing of the feedback, the medium of the feedback, and the constructive nature of the feedback, would effect perceived fairness of the monitoring (see figure 3). Monitoring fairness would effect both task performance and task satisfaction. Alder and Ambrose had 165 university students enter catalogue orders into a computer system, incentives were provided for increased input of orders. There was no evidence that control over the timing of the feedback improved perceived fairness, but this may have been due to the short nature of the task (2 hours) limiting the worth of such control. Also, no evidence supported the proposed interaction between the medium and the constructiveness of the feedback. Constructiveness had a large effect on monitoring fairness (Beta = 0.79) and feedback medium had a moderate effect (Beta = .34). The result in regard to medium is of particular interest. In this case the feedback came either direct from the computer, or via the supervisor. Alder and Ambrose were concerned that the presence of the supervisor would magnify the negative effect of destructive criticism. It turned out that using a supervisor to provide the feedback improved the constructive criticism, but had a small positive effect in terms of destructive criticism. It may be the advantage of face to face feedback is that the recipient can respond to the supervisor, either by offering some excuse or explanation for poor performance, or to voice

disapproval of the feedback. The Alder and Ambrose study, and many of the others discussed above, used university students as participants in experiments, and thus the results may not translate to other populations in industry outside education. Nevertheless, Alder and Ambrose do provide some support for using supervisors to provide computer generated feedback in regard to performance, whilst Wouters and Bos (2000) and Sheahan and Biggs (2005), which were based on worker or trainee samples, provide support for the use of feedback with commercial drivers.

See Appendix for Figure 3

Current and Future Directions for the Project

Queensland Taxi Driver Questionnaire

Table 4 summarizes the QTDQ sections and how they relate to the TPB, and the frequency that particular driving behaviours are measured in each section. Except for in section A, most questions utilize Likert scales, asking for response by either strength of agreement, frequency, or strength of influence. Questions were taken from a number of other scales, as well as developed particularly for this project. Because of unique features of the taxi industry the wording of many questions that did come from other scales had to be adjusted: For example, any questions that referred to drivers as employees had to be changed as taxi drivers are self-employed.

Table 4
The sections of the QTDQ with the number of questions for relevant driving behaviours.

Section and subject of questionnaire	Total	Rush	Speed	Tailgate	Speed & tailgate	Traffic Light	Stop/give-way signs	Lights & signs	Fatigue	Pedestrians	Distraction	Inattention	Other
A – Demographic and driving history	26	0	0	0	0	0	0	0	5	0	0	0	21
B – Perceived behavioural control[a]	8	0	2	1	0	1	1	0	1	1	1	0	0
C – Driving behaviour[a]	38	5	3	1	0	1	1	0	3	3	4	4	13
D – Security	5	0	0	0	0	0	0	0	0	0	0	0	5
E – Training	7	0	0	0	0	0	0	0	0	0	0	0	7
F – Driving intentions[a]	15	1	2	2	0	1	1	0	1	1	2	1	3
G – Driving and work attitudes[a]	27	1	4	4	0	1	1	0	1	1	2	0	12
H – Subjective norms[a]	24	2	2	2	0	4	2	0	2	2	2	0	6
I – Perceived demands on driving	14	0	2	1	4	2	0	4	1	0	0	0	0
J - Conclusion	4	0	0	0	0	0	0	0	0	0	0	0	4
Total	168	9	15	11	4	10	6	4	14	8	11	5	71

Note. [a]Sections directly related to the TPB.

Demographic and driving history. In the driving history section drivers are asked to self-report how many crashes they have had in the previous 12 months. Arthur Jr. et al. (2001) compared the use of self-report crash data to that collected by a transport department

through the police. Many crashes are not reported to the police for reasons that include the crash being under a minimum value for mandatory reporting, and the participants choosing not to report the crash. Of those crashes that were reported there may be inaccuracies in the information: For example, participants may not want to incriminate themselves. Arthur Jr. et al. compared the state department's crash and traffic violation records of 394 participants, to their self-reports. Participants self-reported, on average, about three times the number of crashes than was recorded and four times the number of violations. Arthur Jr. et al. noted that the boundary conditions on archival data make that data different to self-report data. If the research interest is in severe crashes, then archival data will be the most accurate. If the interest is all crashes for the relevant drivers, as for this taxi study, then self-report data are more appropriate. Some items in this section ask for a short answer, for example: Approximately how many hours did you work taxi shifts last week? Other items involved ticking one of several possible answers, for example: I most often drive: day shift…, night shift…, about the same of each…. A question with a series of scenarios for what the driver does when tired (e.g., end your shift early) had a Likert scale from 0 = never to 5 = always.

Perceived behavioural control. This section measures drivers' perception of how easily they can undertake certain driving activities. It was originally based on questions from another taxi study (Dalziel & Job, 1997) on optimism bias. However, there are problems with measuring optimism bias, in particular, the ambiguity of average (Groeger & Grande, 1996). Additionally, the questions needed to be adjusted to be more suitable to the taxi industry, for example by specifying speeding on urban streets, and including interaction with pedestrians. Questions were further adjusted to fit the PBC concept in the TPB. Versions of the questions were trialled with drivers. Published PBC questions in the road safety domain cover a limited range of behaviours, for example, speed (Stead et al., 2005) and violations (Parker et al., 1992), the questions in terms of ease or difficulty one has in avoiding (or performing) various activities. Thus, the PBC questions in the QTDQ have been developed specifically for the project. The items were answered on a Likert scale ranging from 1 = very easy to 6 = very difficult.

Driving behaviour. Crashes are relatively rare: an alternative measure of success is a reduction in unsafe driving behaviour, such as speeding and running red lights, and an increase in safe driving behaviour. Drivers can be asked to self-report on their driving behaviour. This is the preferable method, despite possibilities of poor recall and social desirability effects, because a variety of specific behaviours of interest to this study can be measured, rather than the particular traffic laws that police enforce. Never-the-less, the self-reporting of demerit points may provide a rough overall estimate of speeding and other driving violations.

Questions in regard to driving behaviour have been developed from the Driving Behaviour Questionnaire (Blockey & Hartley, 1995; Parker, Reason, Manstead, & Stradling, 1995; Reason, Manstead, Stradling, Baxter, & Campbell, 1990). The DBQ has been modified for the fleet questionnaire at the Centre of Accident Research and Road Safety, Queensland (CARRS-Q) to simplify a number of the questions and to make it more applicable to the fleet setting. Further modification has been made to make it applicable to the taxi industry. Thus, "Park on a double yellow line and risk a fine" has become "Park or pick up a passenger in a clearway (or similar)". "Do paperwork or other admin while driving" was first written into the CARRS-Q fleet questionnaire, whilst "Quickly do U-turns or cut across traffic to pick up or drop off a passenger" was created for this study. When the original questionnaire was trialed 36 of the 50 questions had a score less than one (Reason et al., 1990), this skewness may be alleviated by adjustments made to the questions. The DBQ has a test-retest reliability of 0.78 (Parker et al., 1995). The items were scored on a scale very

similar to the original DBQ, ranging from 0 = never to 5 = always (rather than the "nearly always" of the DBQ).

Security. The categories of abuse potentially received by drivers were based on an earlier study on security in the Victorian taxi industry (Haines, 1997). The scale used was developed for the preliminary QTDQ and produced results in line with expectations: Fare evasion and verbal abuse was experienced a few times a year, more serious abuse was generally experienced less than once a year. While this is not part of the proposed model, and security may have a limited relationship to road safety, there were two reasons to include the questions. Security from passengers is an important issue for drivers, thus the questions and the results have great interest to the drivers and the industry as a whole. Additionally, security cameras were introduced into taxis in Brisbane as the questionnaire was going out, the results of this section can form baseline data to help measure the success of the security camera program. A Likert scale ranging from 0 = Never, through 3 = about once a month, to 6 = several times a shift, produced appropriate results in the preliminary survey.

Training. There are two purposes to this short section of the questionnaire. The first is to discover if drivers found initial training useful, both in regard to both road safety and security from aggressive passengers. The second reason is to find out how many drivers undertake subsequent training. Discussions with industry members suggest this will be a limited number of drivers, except perhaps for those who have been to a taxi council video and talk session at their depot, and as such there is likely to be little effect on road safety behaviours or outcomes. There is a mixture of Likert scale and short answer questions in this section.

Intentions. Victoir, Eertmans, Van den Bergh, and Van den Broucke (2005) measured intentions using questions that were quite general, for example: "I intend to pay special attention to minding the traffic rules." A questionnaire developed for fleets by CARRS-Q proved more helpful. Of the 15 questions in the QTDQ, 12 come from the CARRS-Q fleet questionnaire, though with some modification where necessary, for example: "Ensure that you do not drive for work if tired or fatigued" became "Ensure that you do not drive a taxi if tired or fatigued". A number of the CARRS-Q fleet questions that were not of high relevance to the taxi industry were culled to help prevent the QTDQ becoming too long, and to concentrate on the identified areas of speed, tailgating, intersection signs and lights, pedestrians, fatigue, and distraction. Scoring is the same as for CARRS-Q fleet questionnaire (1 = never to 5 = always).

Attitudes. This section also drew heavily on the CARRS-Q fleet questionnaire, which was partly based on the Driver Attitude Questionnaire. Again it was necessary to make changes and additions to ensure all identified taxi crash risks were accounted for, for example: "It is very important to continually lookout for pedestrians" was added because pedestrians were over-represented in taxi crashes. Attitudes are scored from 1 = strongly disagree to 7 = strongly agree.

The attitudes section also includes items not directly related to with road safety, in particular, items related to "intention to quit" and "service orientation". The two "customer focus" questions (factor loadings of 0.87 and 0.74) from a service orientation scale (Kim, Leong, & Lee, 2005) were included in the current attitude section. Customer focus questions were included because a number of depot managers and taxi drivers indicated there was a connection between drivers who kept clean cabs and tried to satisfy passengers, and safety. The preliminary survey found that drivers who thought customer safety was important had fewer crashes, but the drivers who tried to satisfy customer demands to meet tight schedules were more likely to crash. Thus, competing customer demands may neutralize any effect of service orientation or customer focus on road safety. Intention to quit (Lauver & Kristof-Brown, 2001) questions were included in the preliminary questionnaire, with polarised results

showing many drivers either wanting to stay in the industry, or wanting to get out, with few drivers being neutral. A bigger sample of drivers may help uncover possible relationships between intention to quit and driving behaviour, crash rates, and other factors.

Subjective norms. One measure of subjective norms used very general driving behaviours, for example: My friends drive safely (Victoir et al., 2005). The items in the QTDQ were developed to include the identified taxi crash risks. In both Victoir et al (2005) and Parker et al. (1992) close family members were included as a reference group, and there was no reason to doubt that close family was more likely than other groups to influence taxi drivers. A second reference group that would be likely to influence taxi driver behaviour more than other groups is other taxi drivers. Each item in this section was asked twice, once in regard to each reference group. The questions were tested with a small number of drivers. The questions employ a Likert scale ranging from 1 = strongly discourage me from to 7 = strongly encourage me to.

Perceived organizational and traffic demands. This section was originally developed to measure PBC, but drivers found it confusing as it attempted to measure frequency of behaviour, control in regard to other groups, and competency, all at the same time. These questions were then rewritten to focus on perceived demands placed on drivers by the taxi organization and road environment. A sample question is "Police enforcement pressures me to obey the speed limit." Responses are given on a Likert scale ranging from 0 = not at all to 5 = overwhelming. Sources of pressure included are the taxi company, taxi owners or depot managers, police, financial needs, congested roads, and passengers. A perception of being pressured will lower a driver's PBC; thus there should be significant relationship between these items and the PBC items. However, this section is also quite exploratory, whist drivers, managers and others talk about pressures on drivers, there is little in the literature that tries to quantify or define that pressure.

Computer-based Driver Assessment

Early in 2006 a magnetic pen operated computer used to assess drivers will be trialled with both novice and experienced taxi drivers. The assessment tool is in the final stages of development by Vigil Systems; being modified for the taxi industry based on data, current assessment guidelines, and other information, provided by a taxi company in Brisbane and from this project. The hardware consists of a tablet computer and a magnetic pen. The computer can be connected to one or two cameras, a GPS receiver, and a motion sensor, or another combination of up to four devices. Vigil Systems has developed software that enables an assessor to mark appropriate boxes as a driver is assessed. If the driver is following too close then the assessor would mark "tailgating", say, which may bring up a submenu of other responses that may be marked. The computer will relate the responses of the assessor to the camera, GPS receiver, motion sensor, or other devices. There is a variety of ways the data collected by the computer may be used. It could be used to simply pass or fail a potential taxi driver: that would underutilize the device. A printed report, including reasons why some driving behaviours are safe or dangerous, and how the driver may drive more safely, can be produced for the driver and other appropriate people. To fully utilize the device, feedback to the driver will include information from all the sensors. If a concern for a particular driver was tailgating, then showing appropriate camera images from the driving assessment, perhaps compared to images of safe following distances, could be included in the feedback to the driver.

To increase the likelihood of the intervention being successful the feedback will need to be constructive, that is, specific, prompt, and considerate. The Vigil Systems assessment tool will provide specific data on which constructive feedback can be based. It is planned that the training manager, or driving assessor, of the taxi company will provide that feedback

to novice taxi drivers, or drivers who have been referred for reassessment. There will be a point, which may not be reached, where a driver's performance is so poor, that the driver will not be accepted by the taxi company. Many drivers may have a few points at which their driving could be improved. However, the drivers who come between these two groups, who may make safe taxi drivers when they are given training, will need the most considerate feedback. In this case considerate feedback will be given with the attitude of: How can the performance of the driver best be improved to ensure they are safe taxi drivers? Considerate feedback will include pointing out what specific safe driving behaviours are already being undertaken by the driver, as well as giving specific ways of improving on unsafe behaviours. Whilst constructive feedback is meant to be prompt, it may need to be staggered if there are several behaviours the driver needs to change to become a safe taxi driver. There may also be a trade-off between promptness and consideration. Giving the feedback immediately after the assessment does not allow consideration of what feedback should be given to the particular driver.

Assessment of the intervention will be by questionnaire and interview. Drivers will be asked to complete the intentions scale of the QTDQ and some other questions both before and after the assessment and feedback. Experienced drivers being reassessed will also be asked to complete the attitude, subjective norm, and PBC sections both before and after the intervention. Both groups of drivers will also be asked to rate the training itself. The assessors will be interviewed before and after the intervention is trialed. The first interview will centre on the perceived strengths and weaknesses of the present assessment system. The second interview will concentrate on the Vigil Systems based feedback intervention, and a comparison of it to the present assessment system. The intervention can be deemed as successful if intended driving behaviours move significantly towards safer driving, and if the assessors find the new system more helpful than the old in instilling safe driving behaviour.

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Appendix
Figures 1, 2, 3

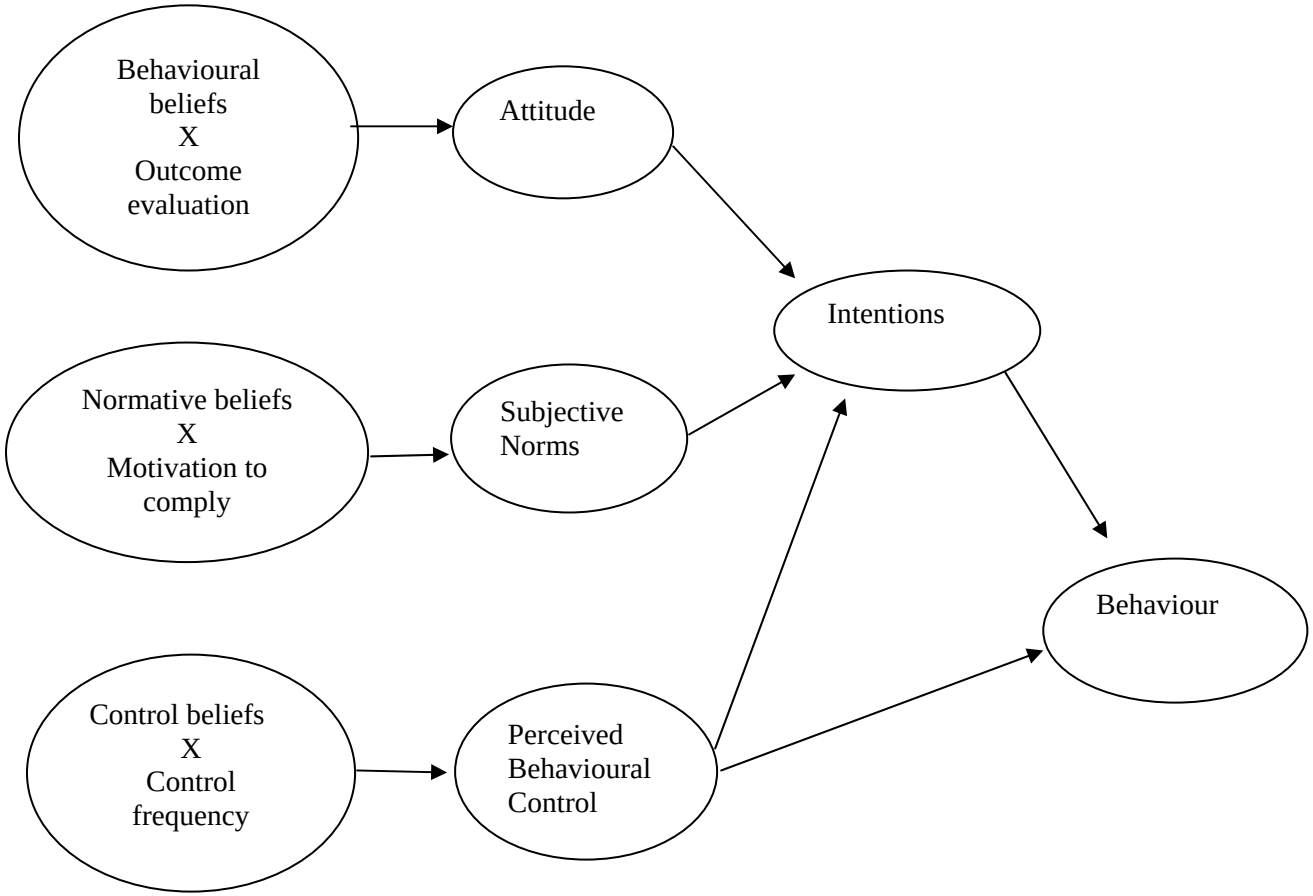

Figure 1
Diagrammatic representation of the Theory of Planned Behaviour (Stead, Tagg, MacKintosh, & Eadie, 2005)

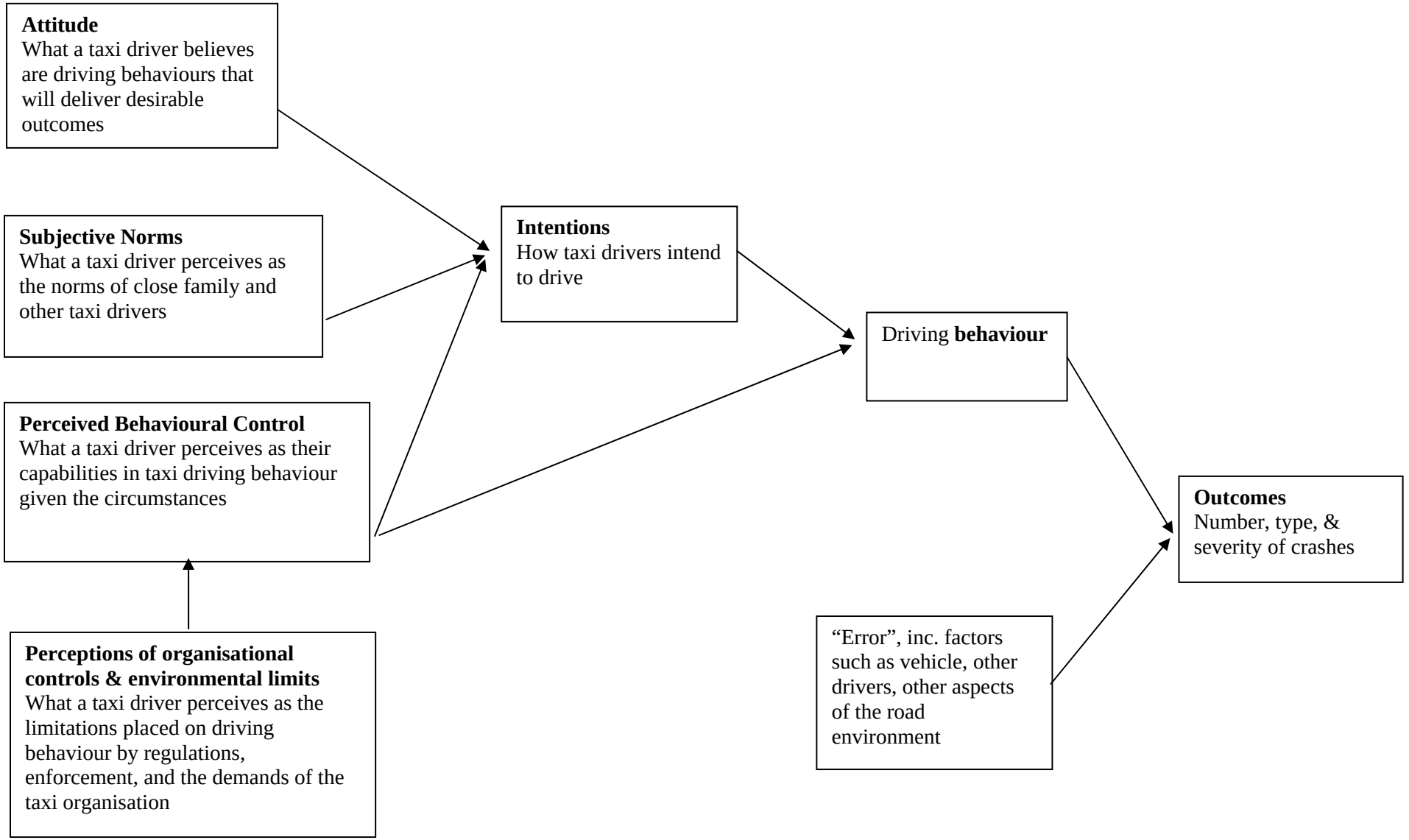

Figure 2
Theory of Planned Behaviour modified for application to the driving behaviour of taxi drivers

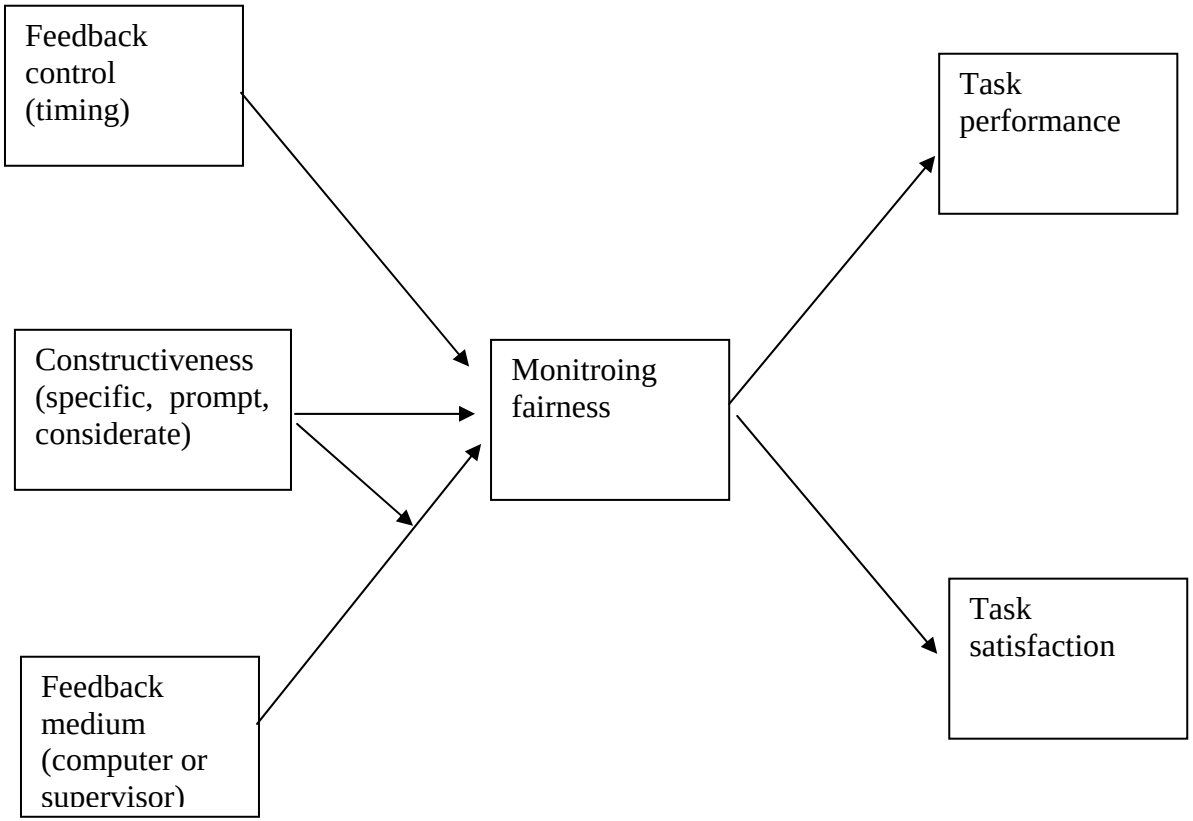

Figure 3. Hypothesised feedback model (Alder & Ambrose, 2005).